

**Re Item V**

**Reasoned statement with regard to novelty, inventive step, and industrial applicability; citations and explanations supporting such statement**

Document EP-A-554533 (D1) is regarded as the closest prior art with respect to claim 1.

It discloses a process for bending workpieces with a bending device (12, 13), a robot arm (11, 12) picking up the workpiece to be shaped and feeding it to the bending device (12, 13). The bending device (12, 13) is stationarily arranged with respect to a surface. The robot grips the workpiece during the bending (D1: column 2, lines 5-6). For further bending, the workpiece is re-fed to the bending device (12, 13) and optionally rotated radially (D1: column 3, lines 51-57).

The subject matter of claim 1 therefore differs from that of the known process at least in that the robot grips the workpiece during the feeding into the at least one bending device during the bending.

Thus the subject matter of claim 1 is novel (PCT Article 33(2)).

The result of this differentiating feature is that the robot arm is involved in the bending and thus is integral to the bending process.

The problem addressed by the present invention is therefore considered to be that of simplifying the bending device so as to dispense with the feed device on the bending device.

The solution proposed in claim 1 of the present invention thus involves an inventive step (PCT Article 33(3)). None of the documents mentioned in the search report discloses or suggests the use of a robot to feed the workpiece into the bending device during the bending.

Claims 2-13 are dependent upon claim 1 and therefore likewise meet the PCT requirements for novelty and inventive step.

Furthermore disadvantageous is that a conventional process for bending workpieces requires manual insertion into the bending device or bending machine. Removal and feeding of the workpieces to a final inspection is likewise primarily effected manually.

It is also known from the prior art that by means of a conventional robot, for example, workpieces can be loaded to a clamping device or collet chuck of a bending machine, said workpieces being subsequently completed in the bending machine. The scope of application of a bending machine is therefore limited.

Additionally, the workpieces must be bent or shaped in a bending machine. If other bending or shaping processes are necessary, the workpiece is fed to an additional bending device for further machining. This permits no precise final inspection of the bending state in the process.

Document EP 0 554 533 A discloses a bending machine that is provided with a handling robot. The handling robot transfers a workpiece to be shaped to the bending head for bending.

Document FR 2 747 599 A discloses a bending machine that is provided with a robot arm. The robot arm removes a pipe to be shaped to feed it to a bending head for bending.

Similar handling systems are disclosed in documents US 5,187,958 A and US 5,182,936

A. Therein, gripping devices are provided above

appropriate arms and serve to remove the workpiece.

The object of the present invention is to provide a process for bending workpieces, particularly pipes, wires, bars, semi-finished products, sheet metal or the like, that overcomes said disadvantages and with which workpieces can be quickly and economically shaped or bent in one production step and optionally an optimized final inspection can occur directly after the bending.

This object is achieved in that at least one robot picks up the workpiece to be shaped and feeds it to the at least one bending device for shaping, in particular bending, the at least one bending device being arranged in a positionally fixed manner with respect to a surface and the at least one robot arm feeding continuously or batch-wise the workpiece for shaping, in particular bending, to the at least one bending device or its bending heads, the robot gripping the workpiece while feeding it into the at least one bending device during bending and, for further bending, feeds it anew to the at least one bending device and rotates the workpiece radially.

In the present invention, the workpiece being picked up and fed, by means of a robot, to a bending unit consisting of at least one bending device has proven particularly

CLAIMS

1. Process for bending workpieces (1), particularly pipes, wires, bars, semi-finished products, sheet metal or the like, with at least one bending device (6), characterized in that at least one robot (3) picks up the workpiece (1) to be shaped and feeds it to the at least one bending device (6) for shaping, in particular bending, the at least one bending device (6) being arranged in a positionally fixed manner with respect to a surface and the at least one robot arm (4) feeding continuously or batch-wise the workpiece (1) for shaping, in particular bending, to the at least one bending device (6) or its bending heads, and the robot (3) gripping the workpiece (1) while feeding it into the at least one bending device (6) during bending and, for further bending, feeds it anew to the at least one bending device (6) and rotates the workpiece (1) radially.
2. Process according to claim 1, characterized in that the robot (3) continuously feeds the workpiece (1) to the at least one bending device (6).
3. Process according to claim 1 or 2, characterized in that a robot arm (4), particularly its gripping device (5) of the at least one

robot (3), picks up the workpiece (1) and directly feeds it to the at least one bending device (6) or directly to its bending head.

4. Process according to at least one of claims 1 to 3, characterized in that the robot arm (4) feeds the workpiece (1) batch-wise to the at least one bending device (6) and the bending device (6) shapes the workpiece (1) at corresponding bending regions, optionally during the shaping the robot arm (4), in particular the gripping device (5), picking up the workpiece (1) by gripping it at any different place, or optionally also in the finished region, to further feed the workpiece (1) into the at least one bending device (6).
5. Process according to at least one of claims 1 to 4, characterized in that the at least one robot (3), particularly the at least one gripping device (5) of the robot arm (4), picks up the workpiece (1) and feeds it to a plurality of bending devices (6) for shaping different radii, bends, angles etc., the workpiece (1) being optionally radially rotatable in the gripping device (5).
6. Process according to claim 5, characterized in that roller bending heads, right-hand/left-hand bending heads, and bending devices with mandrel devices, folding devices or the like are used as bending devices (6).

7. Process according to at least one of claims 1 to 6, characterized in that the at least one robot (3), in particular the robot arm (4), removes the workpiece (1) from a supply bin (2), feeds it to the bending device (6) for shaping or bending and subsequent to bending to a storage area (8) for further machining, said robot again picking up a workpiece (1) to be shaped or bent from the supply bin (2).
8. Process according to at least one of claims 1 to 7, characterized in that subsequent to the shaping or bending of a workpiece (1), it is guided by the at least one robot (3) along a measuring device (9) so as to detect the shapes or bends as a desired value, a process inspection being conducted upon comparison of said value with a stored and selected desired value and optionally a re-shaping or re-bending being effected by means of the robot (3) re-feeding the workpiece (1) to the at least one bending device (6).
9. Process according to claim 8, characterized in that subsequent to re-bending or re-shaping, the workpiece (1) is re-fed, by means of the robot (3), to the measuring device (9) and only after there is agreement between the desired value and measured value or with the predetermined tolerance ranges is the workpiece (1) fed to the storage area (8) or to further machining.

10. Process according to at least one of the claims 1 to 7, characterized in that the workpiece (1) is delivered to another robot, a conveyor belt, a machine, a supply bin or the like as a storage area (8) or for further machining.
11. Process according to at least one of claims 1 to 10, characterized in that the robot (3) picks up the workpiece (1) and directly feeds it in selectable regions that are to be shaped to the bending device (6) or its bending heads, removes it subsequent to shaping, and feeds other regions or end parts of the workpiece (1) for further machining or shaping, after complete processing of the workpiece (1) the robot (3), particularly its gripping device (5), supplying the workpiece (1) for delivery or additional processing.
12. Process according to at least one of the claims 1 to 11, characterized in that the bending unit (7), particularly the bending device (6), can be manually and/or automatically moved with respect to the position of the robot (3).
13. Process according to claim 12, characterized in that the bending unit (7), particularly the bending device (6), can automatically or with a cross slide travel a linear system in a selectable direction or along a selectable guide system with respect to the position of the robot (3), the corresponding position coordinates being transferred to the robot (3).